



US006480191B1

(12) **United States Patent**  
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(10) **Patent No.:** **US 6,480,191 B1**  
(45) **Date of Patent:** **Nov. 12, 2002**

(54) **METHOD AND APPARATUS FOR RECORDING AND PLAYBACK OF MULTIDIMENSIONAL WALKTHROUGH NARRATIVES**

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **09/407,009**

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(22) Filed: **Sep. 28, 1999**

(74) *Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman LLP

(51) **Int. Cl.**<sup>7</sup> ..... **G06T 15/00**

(57) **ABSTRACT**

(52) **U.S. Cl.** ..... **345/419; 345/473; 345/629; 345/723; 707/500**

A method and apparatus for recording and playback of multidimensional walkthrough narratives. A three dimensional modeling language is used to automatically create a simple three-dimensional environment using pre-existing electronic documents. A first user, or author may navigate throughout the three-dimensional environment while at the same time recording the path taken and any accompanying audio. In one of two playback modes, a second user can be shown a "walkthrough" of the three-dimensional scene corresponding to the path taken by the author. In the other playback mode, a second user is free to navigate the three-dimensional world while the author's path is displayed.

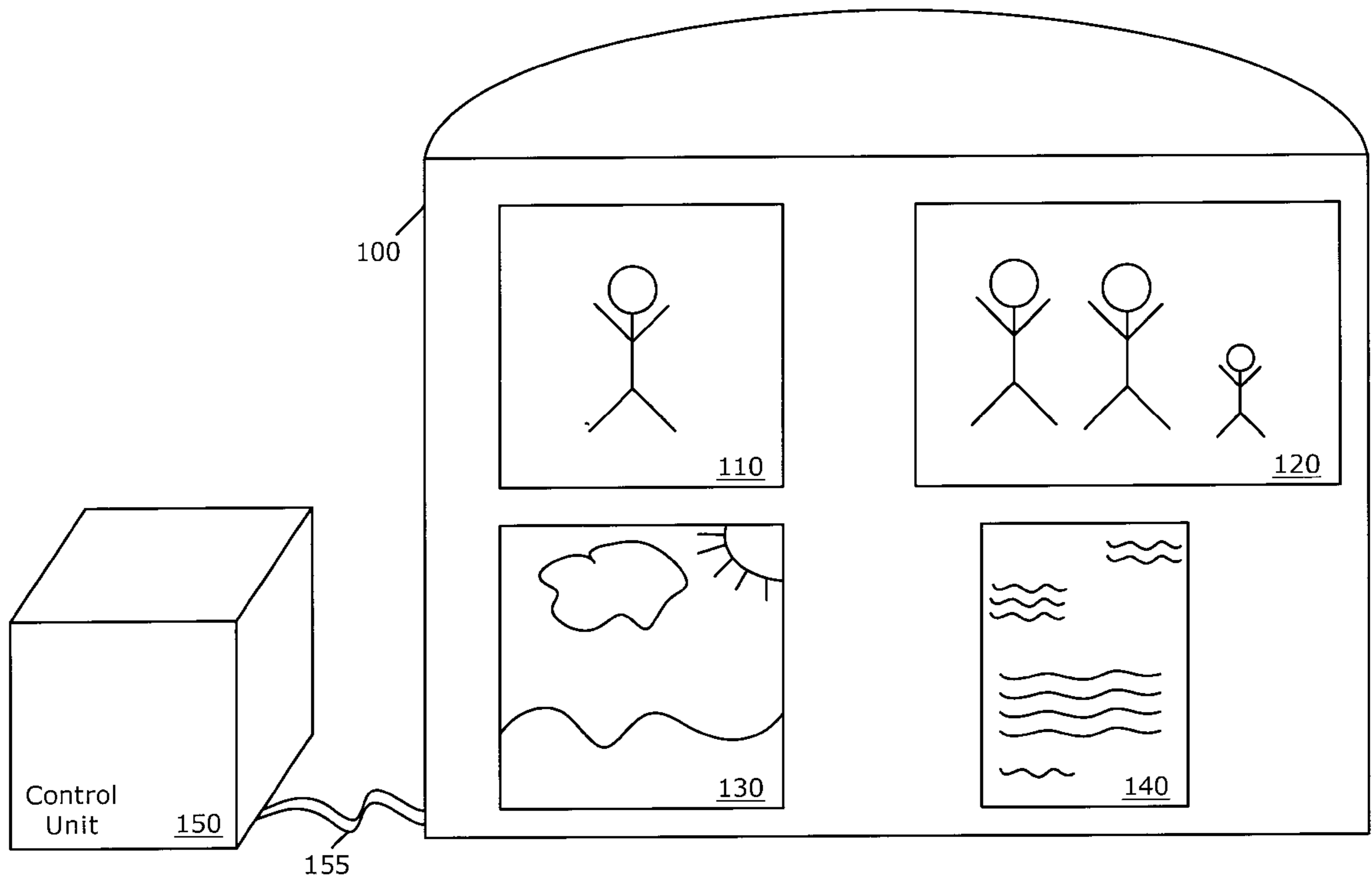
(58) **Field of Search** ..... 345/419, 629, 345/473, 723; 709/204, 217; 705/5; 463/9, 1; 707/500

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**44 Claims, 11 Drawing Sheets**



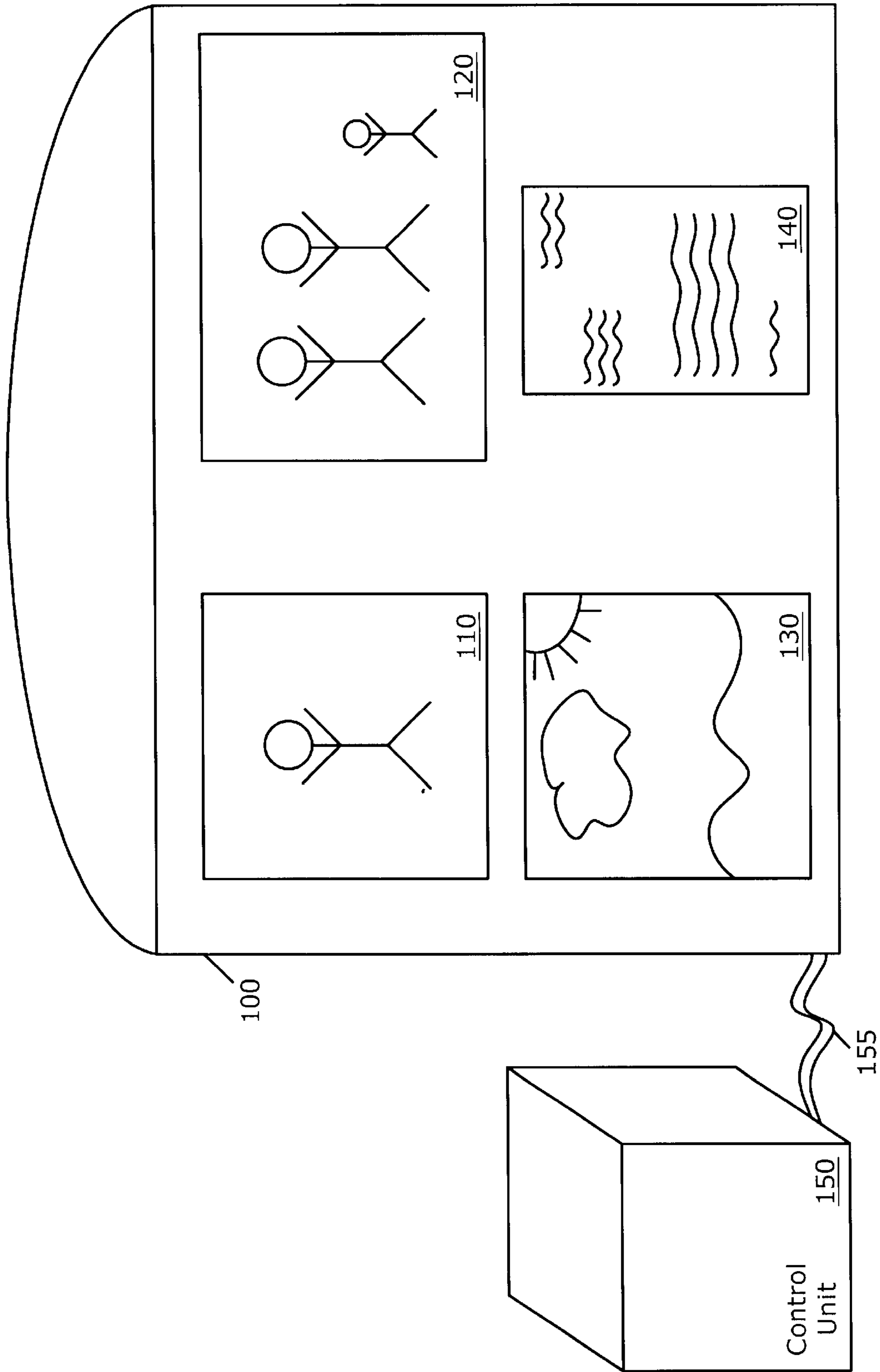


FIG. 1a

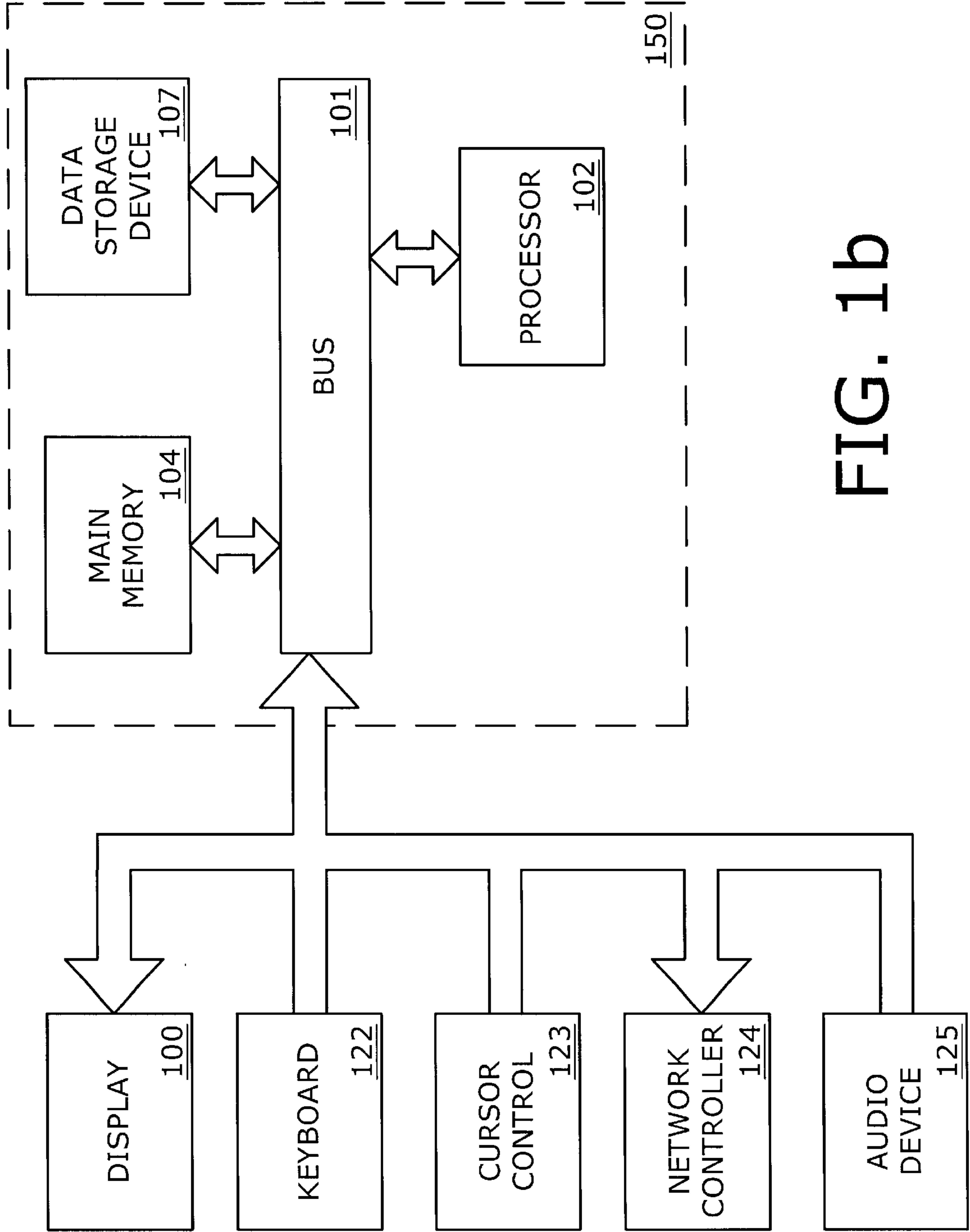


FIG. 1b

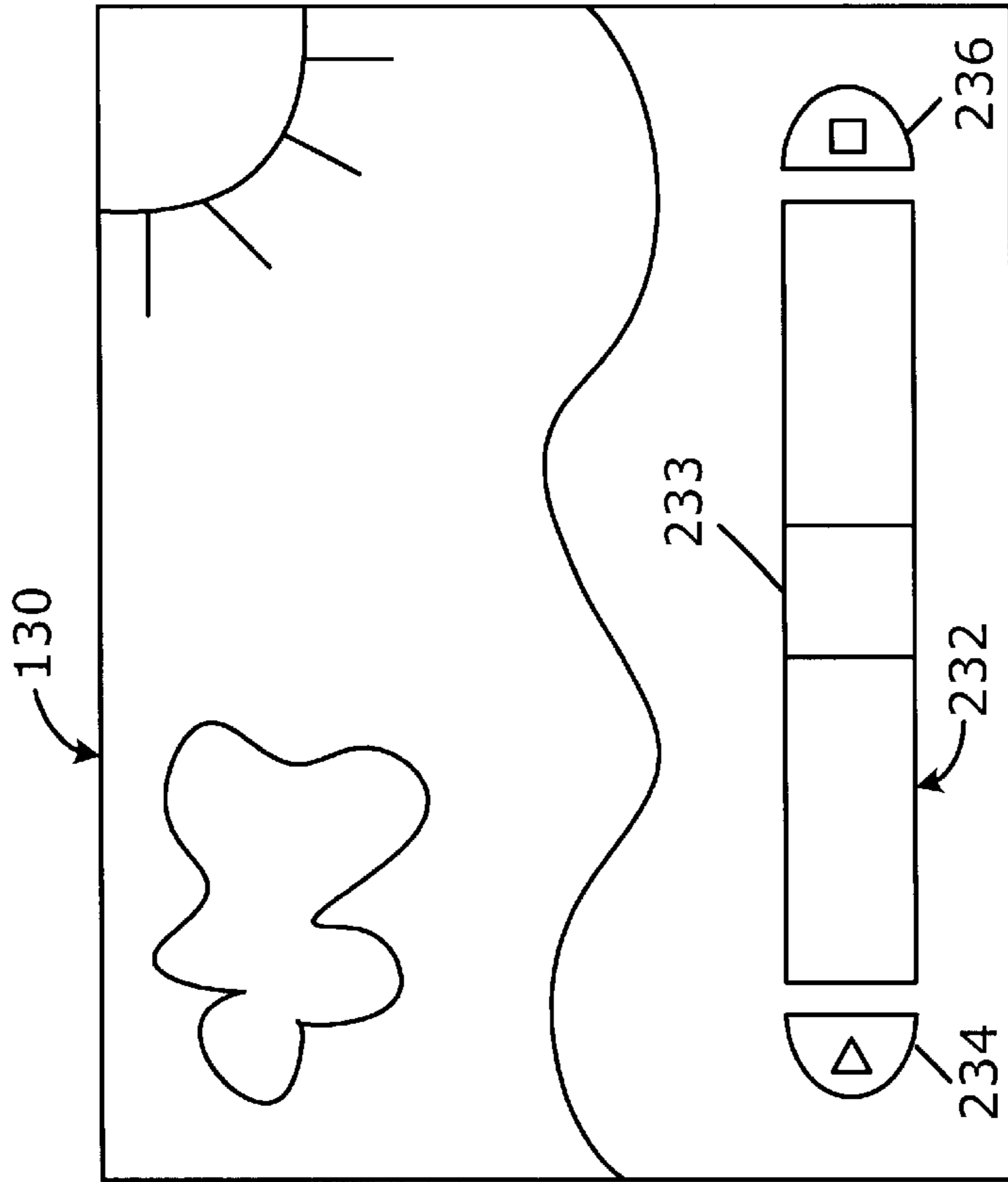


FIG. 2a

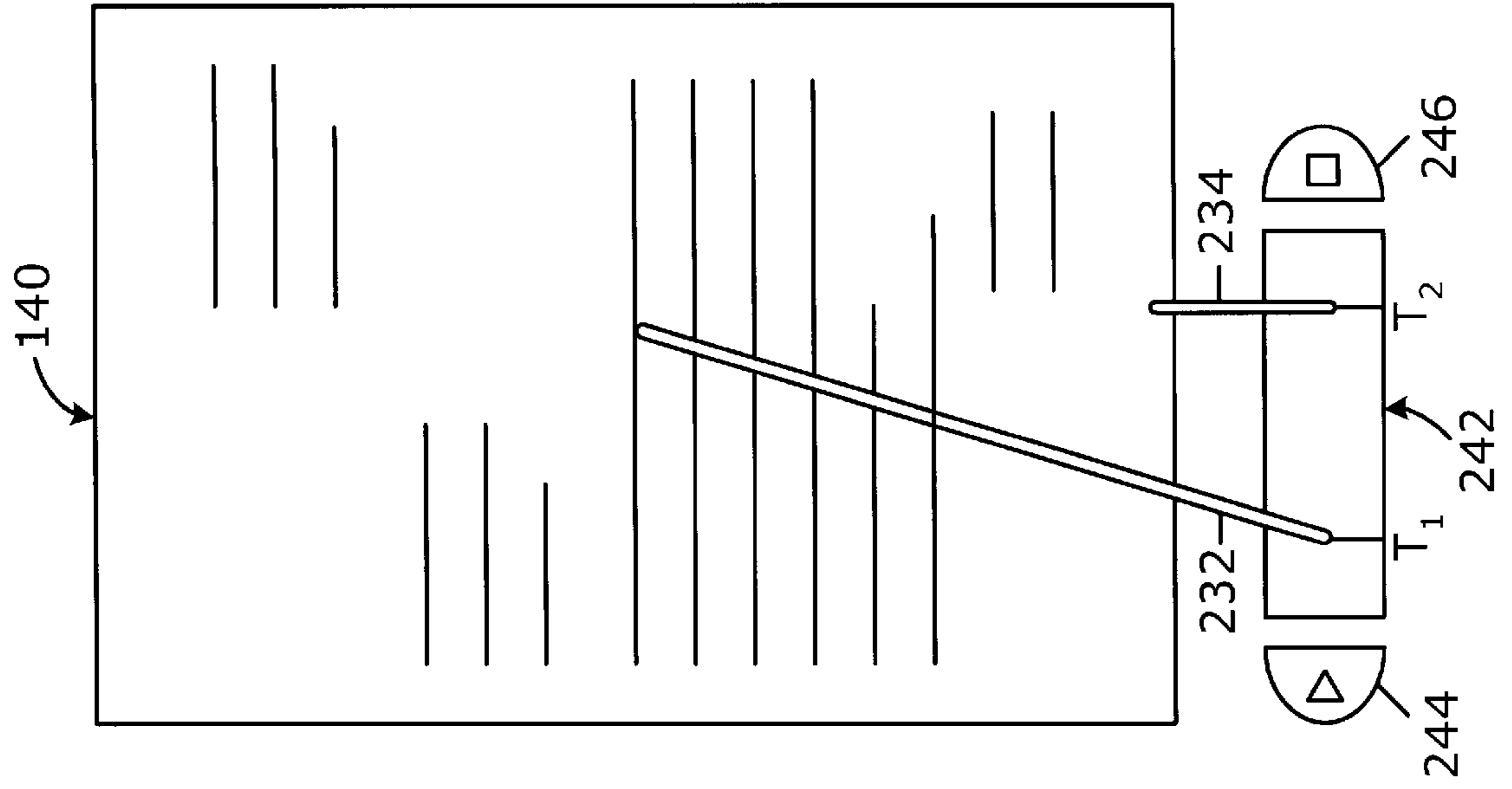


FIG. 2b

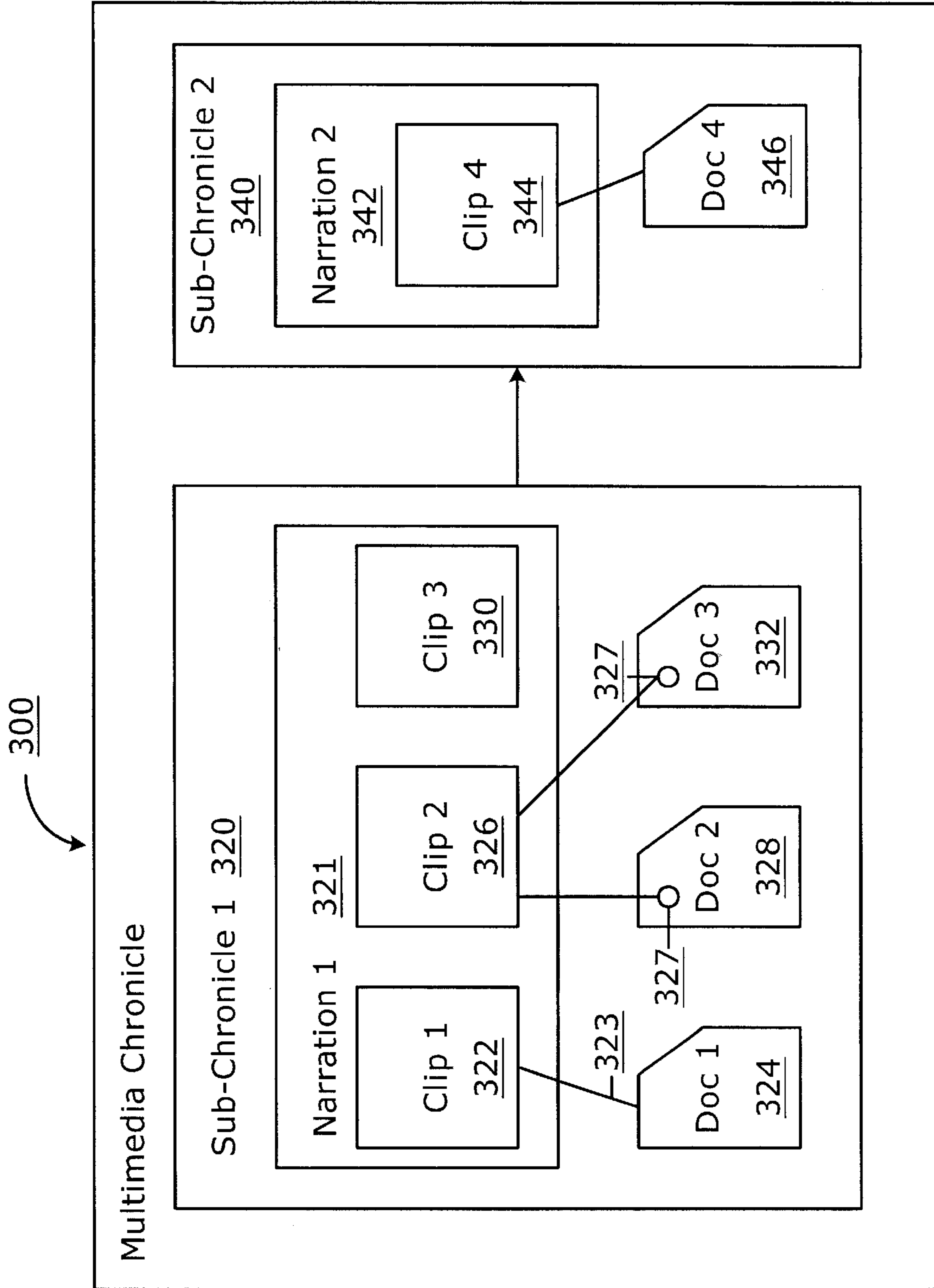


FIG. 3a

```
<CHRONICLE SAVETIME= "927336993806" AUTHORID="marko">
<SUBCHRONICLE AUTHORID="marko" STARTTIME="927336940440">
<CLIP><AUDIOREFS LENGTH="3240">
<AUDIO SRC="http://Server/Clip1.au"/>
<CLIPREF TIME="1753" REF="http://Server/Doc1"/>
</AUDIOREFS></CLIP>
<CLIP><AUDIOREFS LENGTH="11600">
<AUDIO SRC= "http://Server/Clip2.au"/>
<CLIPREF TIME= "2293" POINTX= "250" POINTY= "750" REF= "http://
Server/Doc2"/>
<CLIPREF TIME= "6259" POINTX= "330" POINTY= "250" REF= "http://
Server/Doc3"/>
</AUDIOREFS></CLIP>
<CLIP><AUDIOREFS LENGTH= "1920">
<AUDIO SRC= "http://Server/Clip3.au"/>
</AUDIOREFS></CLIP>
</SUBCHRONICLE>
<SUBCHRONICLE AUTHORID= "marko" STARTTIME= "927336977200">
<CLIP><AUDIOREFS LENGTH= "6560">
<AUDIO SRC= "http://Server/Clip4.au"/>
<CLIPREF TIME= "4086" REF= "http://Server/Doc4"/>
</AUDIOREFS></CLIP>
</SUBCHRONICLE>
</CHRONICLE>
```

FIG. 3b

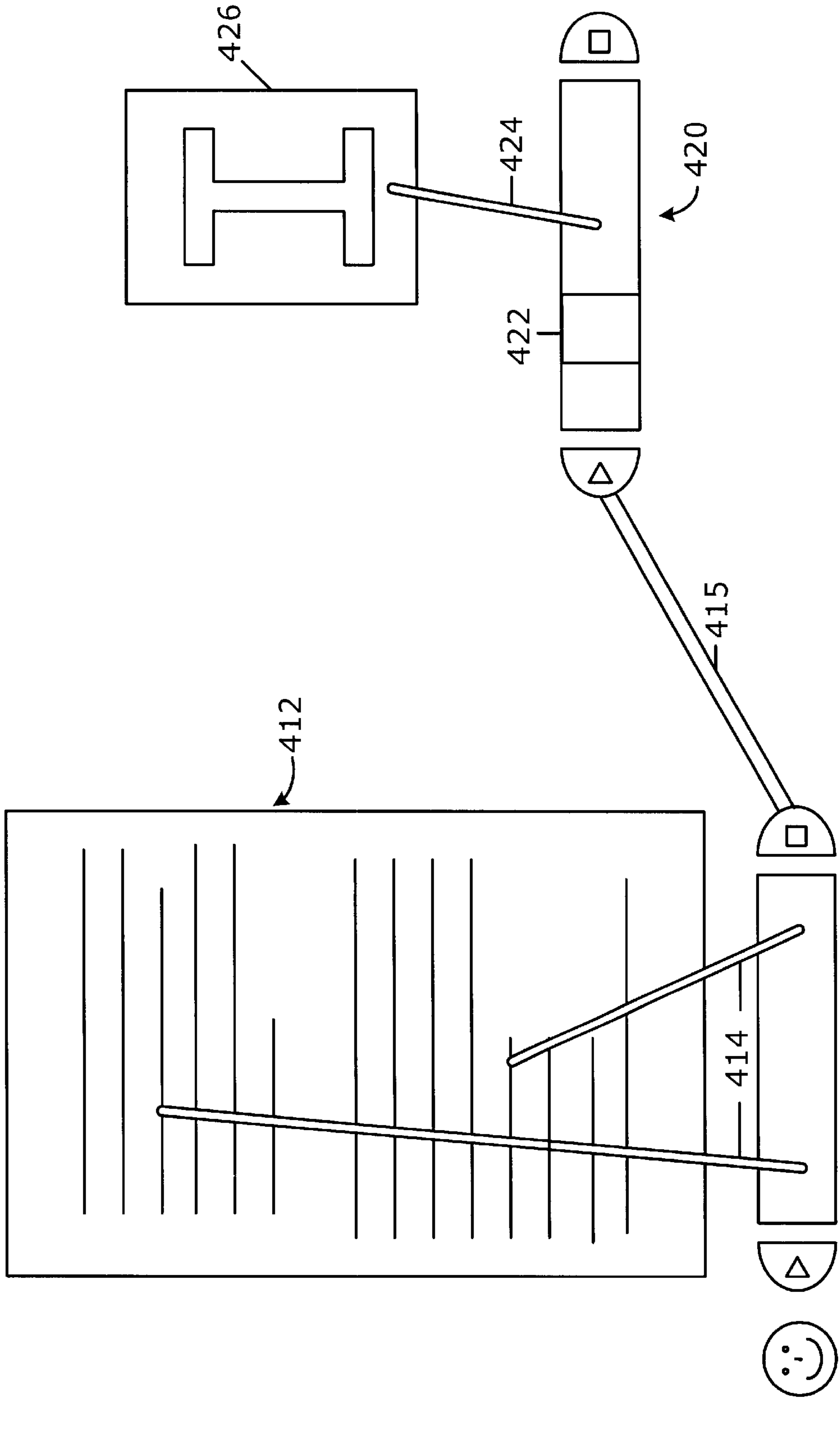
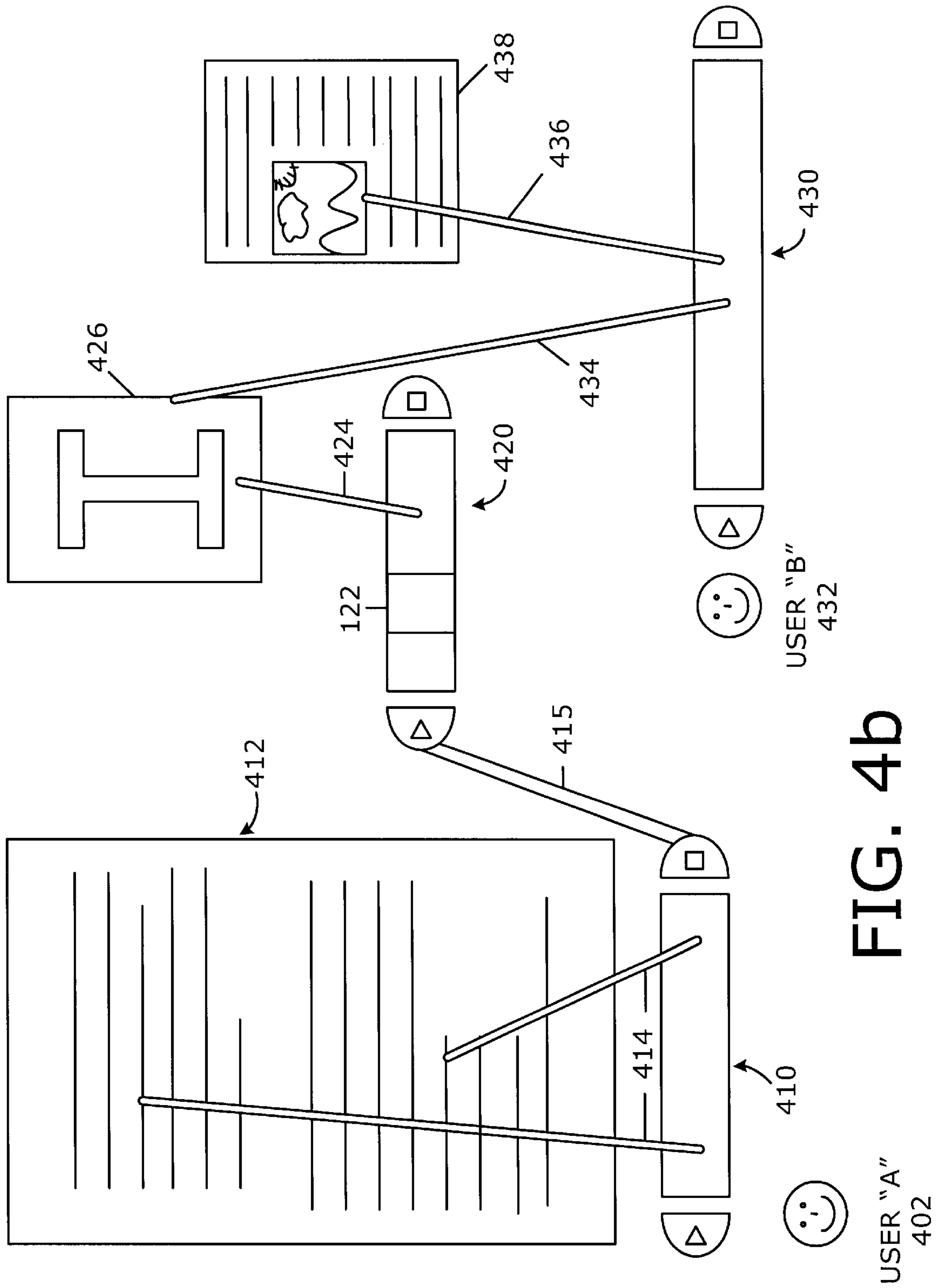


FIG. 4a





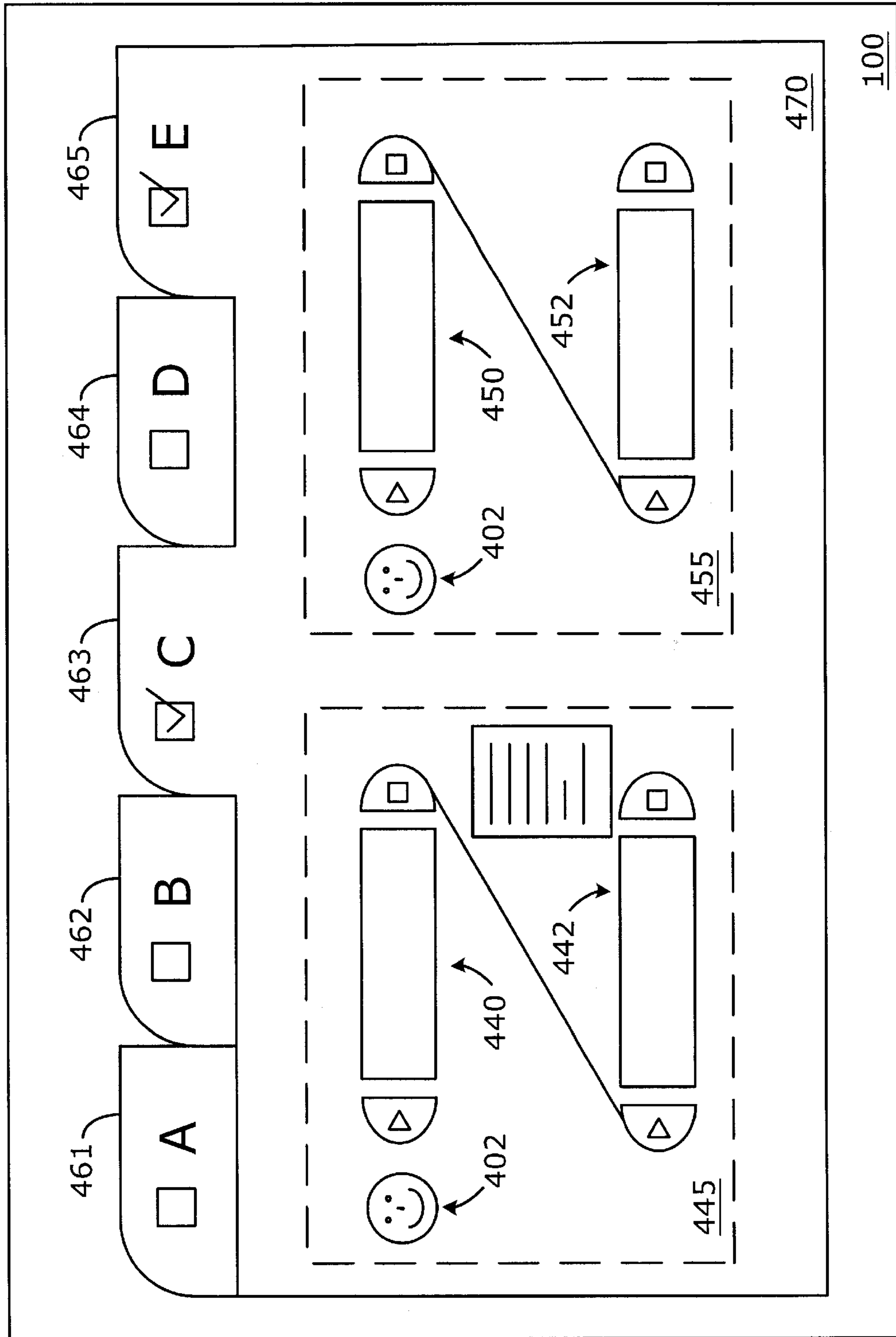


FIG. 4C

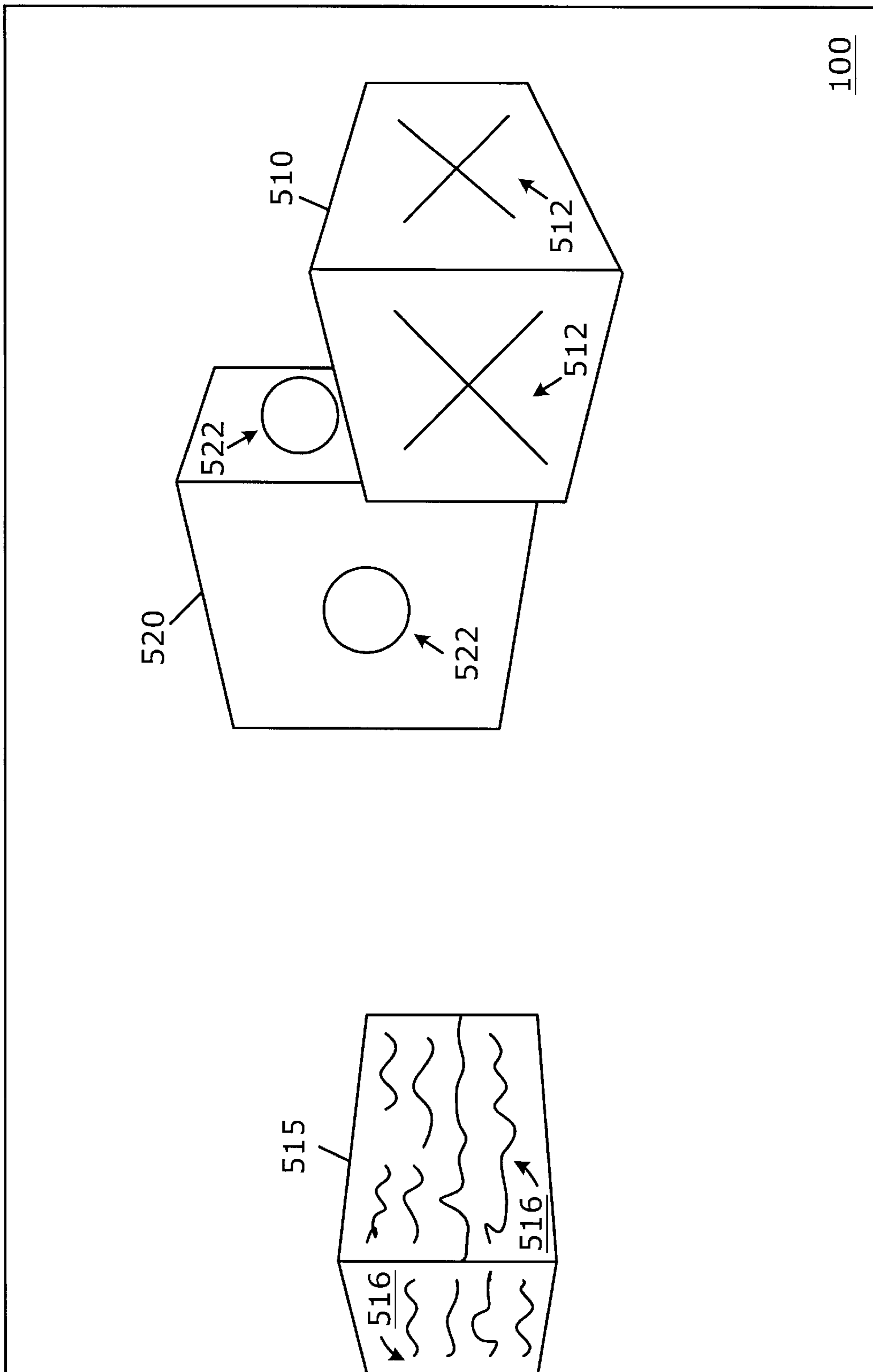


FIG. 5

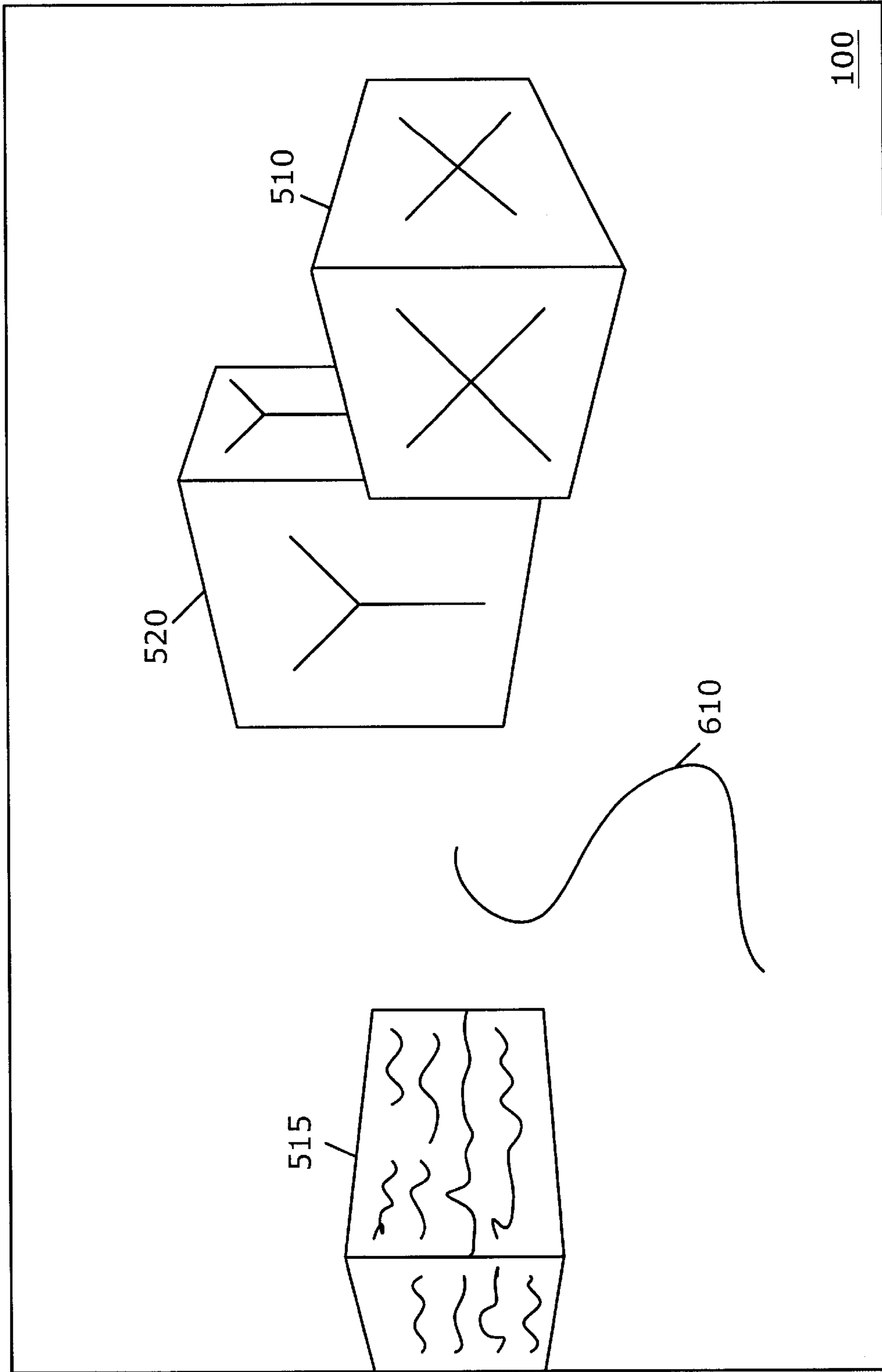


FIG. 6

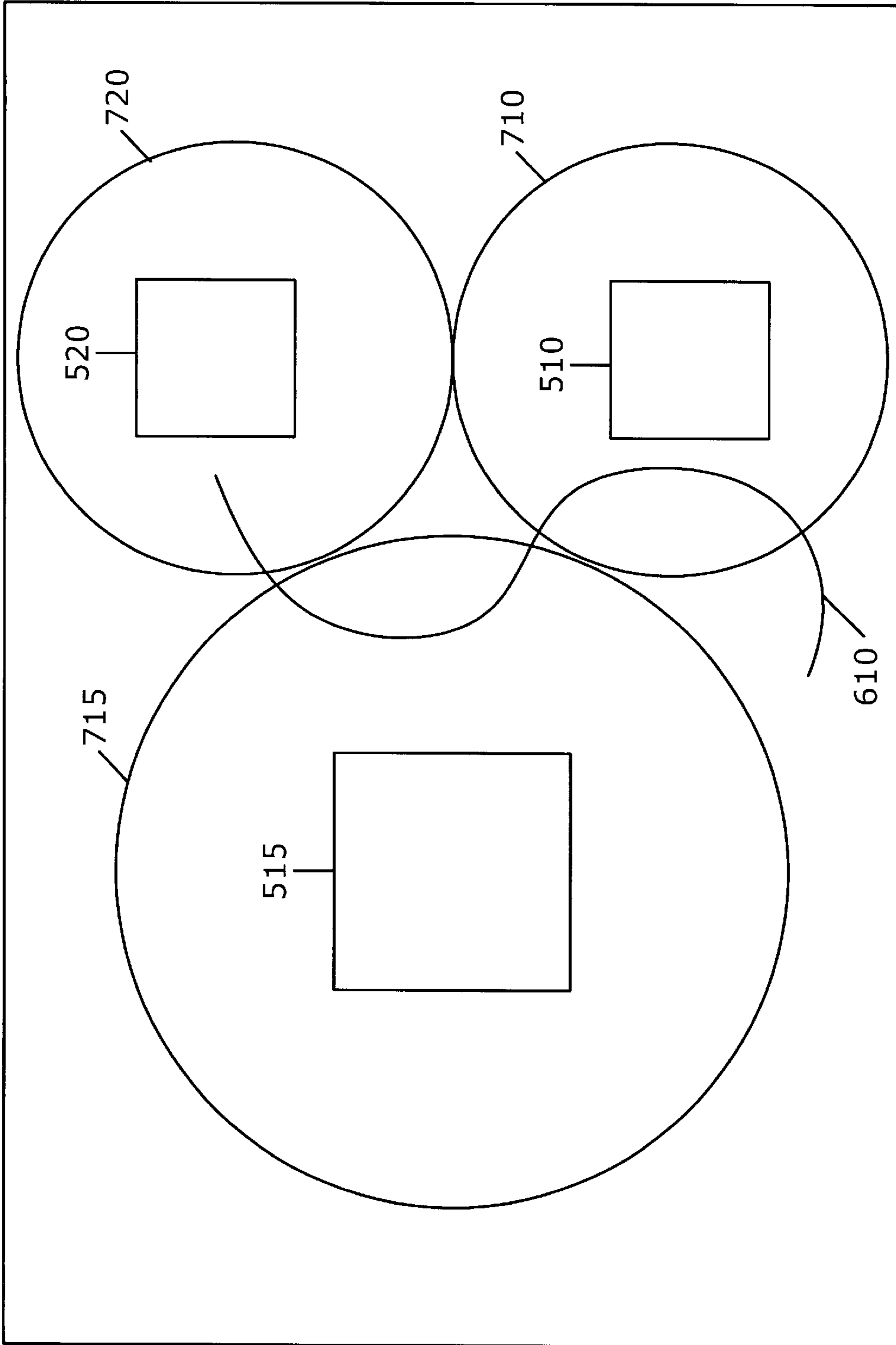


FIG. 7

# METHOD AND APPARATUS FOR RECORDING AND PLAYBACK OF MULTIDIMENSIONAL WALKTHROUGH NARRATIVES

## FIELD OF THE INVENTION

The invention relates to the field of authoring of electronic information; more specifically, this invention relates to a method and apparatus for recording and playback of multi-dimensional walkthrough narratives.

## BACKGROUND OF THE INVENTION

It has been asserted that a large percentage of a typical person's day is spent communicating with others through various mechanisms including oral and written media. Further, there is often a tradeoff between rich, oral communication media and less rich, written communication media. While oral media enable negotiation, clarification, explanation and exchange of subjective views, written media enable the exchange of large amounts of accurate, objective or numeric data.

This dichotomous relationship between oral and written communication similarly exists within the electronic realm. Simple textual email messages, although easy to author, typically do not allow rich, expressive communication as may sometimes be required. On the other hand, tools for creating richer, more expressive messages, such as multimedia presentation software, are too complex and time-consuming for casual or day-to-day use. Furthermore, multimedia presentation software typically is not designed to be used as an communication tool. Multimedia "documents" produced using this software tend to present information to an audience, rather than allow user interaction and self-guided learning.

Therefore, what is needed is a method for creating a simple and effective multimedia authoring tool that overcomes the limitations found within the prior art.

## SUMMARY OF THE INVENTION

A method and apparatus for creating and/or playing back walkthrough narratives is described. In one embodiment, the method includes generating a multidimensional representation of electronic documents within a three-dimensional environment, recording a narrative of the multidimensional representation, and storing the multidimensional representation and the narrative to allow playback in at least one of multiple modes.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated by way of example, and not by way of limitation in the figures of the accompanying drawings in which like reference numerals refer to similar elements.

FIG. 1A illustrates an electronic display upon which is shown electronic documents are.

FIG. 1B is a block diagram illustrating one embodiment of a computer system.

FIG. 2A illustrates an electronic document in the form of a digital photograph displayed with one embodiment of an associated audio gauge.

FIG. 2B illustrates one embodiment of an audio gauge that includes reference markers.

FIG. 3A is a block diagram illustrating one embodiment of an exemplary multimedia chronicle.

FIG. 3B illustrates one embodiment of an XML representation for the multimedia chronicle shown in FIG. 3A.

FIG. 4A illustrates another embodiment of a multimedia chronicle.

FIG. 4B illustrates one embodiment of a reply to an electronic mail message containing the multimedia chronicle shown in FIG. 4A.

FIG. 4C illustrates one embodiment of a multimedia chronicle messaging interface that allows segments of the multimedia chronicle to be selectively viewed.

FIG. 5 illustrates one embodiment of a three-dimensional environment.

FIG. 6 illustrates one embodiment of a three-dimensional environment showing a path.

FIG. 7 illustrates a two-dimensional top view of the three-dimensional environment of FIG. 6.

## DETAILED DESCRIPTION

A method and apparatus for generating visual representations is described. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the invention. It will be apparent, however, to one skilled in the art that the invention can be practiced without these specific details. In other instances, structures and devices are shown in block diagram form in order to avoid obscuring the invention.

Reference in the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment.

Some portions of the detailed descriptions that follow are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

The present invention also relates to apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, and magnetic-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, or any type of media suitable for storing electronic instructions, and each coupled to a computer system bus.

The algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general purpose systems may be used with programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method steps. The required structure for a variety of these systems will appear from the description below. In addition, the present invention is not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the invention as described herein.

FIG. 1A illustrates an electronic display device upon which various electronic documents are displayed. Referring to FIG. 1A, display device **100** may comprise any device equipped to display electronic images and data as described herein. Display device **100** may be, for example, a cathode ray tube (CRT), liquid crystal display (LCD), or any other similarly equipped display device, screen, or monitor. In one embodiment, display device **100** is equipped with a touch screen in which a touch-sensitive, transparent panel covers the screen of display device **100**. Additionally, display device **100** is shown coupled to control unit **150** by connector cable **155**. Connector cable **155** may be external or internal to display device **100**.

Control unit **150** may comprise an arithmetic logic unit, a microprocessor, a general purpose computer, a personal digital assistant or some other information appliance equipped to provide electronic display signals to display device **100**. In one embodiment, control unit **150** comprises a general purpose computer having a graphical user interface, which may be generated by, for example, WINDOWS® or JAVA® based operating systems. In one embodiment, electronic documents **110**, **120**, **130**, and **140** are generated by one or more application programs executed by control unit **150** including, without limitation, word processing applications, electronic mail applications, spreadsheet applications, and web browser applications. In one embodiment, the operating system and/or one or more application programs executed by control unit **150** provide “drag-and-drop” functionality where each electronic document, such as electronic documents **110**, **120**, **130**, and **140**, may be encapsulated as a separate data object.

Referring still to FIG. 1A, connector cable **155** represents any connector cable known in the art to route display signals from a device such as control unit **150** to a display device such as display device **100**. In an alternative embodiment, control unit **150** may be situated within display device **100** and the use of connector cable **155** may not be required or may be internal to display device **100**.

FIG. 1B is a block diagram of one embodiment of a computer system. Referring to FIG. 1B, control unit **150** is shown including processor **102**, main memory **104**, and data

storage device **107**, all of which are communicatively coupled to system bus **101**.

Processor **102** processes data signals and may comprise various computing architectures including a complex instruction set computer (CISC) architecture, a reduced instruction set computer (RISC) architecture, or an architecture implementing a combination of instruction sets. Although only a single processor is shown in FIG. 1B, multiple processors may be included.

Main memory **104** may store instructions and/or data that may be executed by processor **102**. The instructions and/or data may comprise code for performing any and/or all of the techniques described herein. Main memory **104** may be a dynamic random access memory (DRAM) device, a static random access memory (SRAM) device, or some other memory device known in the art.

Data storage device **107** stores data and instructions for processor **102** and may comprise one or more devices including a hard disk drive, a floppy disk drive, a CD-ROM device, a DVD-ROM device, a DVD-RAM device, a DVD-RW device, a flash memory device, or some other mass storage device known in the art.

System bus **101** represents a shared bus for communicating information and data throughout control unit **150**. System bus **101** may represent one or more buses including an industry standard architecture (ISA) bus, a peripheral component interconnect (PCI) bus, a universal serial bus (USB), or some other bus known in the art to provide similar functionality.

Additional components coupled to control unit **150** through system bus **101** include display device **100**, keyboard **122**, cursor control device **123**, network controller **124** and audio device **125**. Display device **100** represents any device equipped to display electronic images and data as described herein. Display device **100** may be a cathode ray tube (CRT), liquid crystal display (LCD), or any other similarly equipped display device, screen, or monitor. Keyboard **122** represents an alphanumeric input device coupled to control unit **150** to communicate information and command selections to processor **102**. Cursor control **123** represents a user input device equipped to communicate positional data as well as command selections to processor **102**. Cursor control **123** may include a mouse, a trackball, a stylus, a pen, cursor direction keys, or other mechanism to cause movement of a cursor. Network controller **124** links control unit **150** to a network that may include multiple processing systems. The network of processing systems may comprise a local area network (LAN), a wide area network (WAN) (e.g., the Internet), and/or any other interconnected data path across which multiple devices may communicate.

Audio device **125** is coupled to system bus **101** and is equipped to receive audio input and transmit audio output. Audio input may be received through various devices including a microphone within audio device **125** and network controller **124**. Similarly, audio output may originate from various devices including processor **102** and network controller **124**. In one embodiment, audio device **125** is a general purpose, audio add-in/expansion card designed for use within a general purpose computer system. Optionally, audio device **125** may contain one or more analog-to-digital or digital-to-analog converters, and/or one or more digital signal processors to facilitate audio processing.

It should be apparent to one skilled in the art that control unit **150** may include more or less components than those shown in FIG. 2 without departing from the spirit and scope of the present invention. For example, control unit **150** may

include additional memory, such as, for example, a first or second level cache, or one or more application specific integrated circuits (ASICs). Similarly, additional components may be coupled to control unit **150** including, for example, image scanning devices, digital still or video cameras, or other devices that may or may not be equipped to capture and/or download electronic data to control unit **150**.

#### Audio-Narratives

In accordance with one embodiment, one can record a variable-length audio narration that may optionally describe one or more electronic documents or images displayed upon a display device. In one embodiment, by indicating a position on a display screen through clicking, pointing, or touching the display screen, audio recording is initiated and a dynamically adjustable audio gauge is displayed. The audio gauge increases in size in proportion to the amount of audio recorded while the audio gauge is active. Audio recording may cease when the audio level drops below a predetermined threshold or may cease in response to specific user input. In one embodiment, for each additional positional stimulus received, a new audio gauge is generated and the previous audio gauge ceases to be adjusted, thereby becoming inactive.

The term “positional stimulus,” as referred to herein, represents an input which can simultaneously indicate an electronic location on the display screen with an instant in time tracked by the control unit. Various input sources may generate a positional stimulus including, without limitation, a computer mouse, a trackball, a stylus or pen, and cursor control keys. Similarly, a touch screen is capable of both generating and detecting a positional stimulus. In one embodiment, positional stimuli are detected by control unit **150**, whereas in another embodiment, positional stimuli are detected by display device **100**.

In an exemplary embodiment, once a positional stimulus occurs, such as a “click” of a mouse or a “touch” on a touch screen, an audio gauge is generated on display device **100** at the location indicated by the positional stimulus. At substantially the same time as the audio gauge is generated, control unit **150**, or a similarly equipped device coupled to control unit **150**, begins to record audio input. In one embodiment, the size of the audio gauge displayed is dynamically adjusted so as to proportionally indicate the amount of audio recorded by control unit **150**, or the similarly equipped device coupled to control unit **150**. Audio may be recorded by control unit **150** through audio device **125** or similar audio hardware (or software), and the audio may be stored within data storage device **107** or a similarly equipped audio storage device. In one embodiment, control unit **150** initiates audio recording in response to detecting a positional stimulus, whereas in an alternative embodiment, control unit **150** automatically initiates audio recording upon detecting audio input above a predetermined threshold level. In another embodiment, a set of on-screen or physical buttons are used to control recording. Buttons for audio control are well-known and include “Record”, “Play”, “Stop”, “Pause”, “Fast Forward”, “Rewind”. Similarly, audio recording may automatically be terminated upon the audio level dropping below a predetermined threshold or upon control unit **150** detecting a predetermined duration of silence where there is no audio input.

FIG. 2A illustrates an electronic document in the form of a digital photograph displayed with an associated audio gauge. Referring to FIG. 2A, electronic document **130** is

shown on display device **100**. In an alternative embodiment, electronic document **130** may appear as a reduced size “thumbnail” representation of a larger image or document.

In one embodiment, audio gauge **232** is displayed overlaid upon electronic document **130** and includes start indicator **234** and stop indicator **236**. Start indicator **234** marks the location at which an initial positional stimulus for audio gauge **232** was detected and stop indicator **236** marks the location at which audio gauge **232** ceased while being dynamically adjusted. In one embodiment, audio gauges cease being dynamically adjusted as a result of audio input ceasing or falling below a minimum threshold level. Since, in FIG. 2A, the positional stimulus associated with audio gauge **232** is detected at a point located on electronic document **130** (indicated by start indicator **234**), audio gauge **232** is subsequently generated on electronic document **130**. In one embodiment, audio gauges are rendered semi-transparently, so that electronic documents located underneath, such as electronic document **130**, remain visible. Audio gauges may graphically display the recorded audio waveform or segments of speech and silence.

Audio recorded according to the methods described herein may be played back or replayed in any of a number of ways. In one embodiment, recorded audio is replayed when control unit **150** detects a positional stimulus indicating a location on, or substantially close to, the start indicator of the associated audio gauge. In another embodiment, recorded audio is replayed when control unit **150** detects a positional stimulus indicating a location on, or substantially close to, any part of the associated audio gauge or electronic document or when the user presses a button as described above.

Audio gauges may also include a replay progress indicator such as progress puck **233**. In one embodiment, as recorded audio is replayed, progress puck **233** moves along audio gauge **232** so as to indicate both the amount of recorded audio replayed as well as the amount of recorded audio remaining to be replayed. In FIG. 2A, progress puck **233** indicates that approximately 50% of the recorded audio associated with audio gauge **232** has been replayed. In other embodiments, progress indicators may take other forms including various geometric shapes or variations in color that progress along audio gauge **232**. In one embodiment, replay of the recorded audio continues while a positional stimulus is detected that indicates a location on or substantially close to stop indicator **236**, or until all previously recorded audio associated with the audio gauge has been replayed. Audio gauges may optionally include a “pause” indicator that, when selected, temporarily suspends recording or playback, and a “resume” indicator that resumes recording or playback after being paused.

Reference markers may also be utilized to enhance understanding of recorded audio content. FIG. 2B illustrates an exemplary audio gauge including reference markers. Referring to FIG. 2B, audio gauge **242** includes start and stop indicators **244** and **246** and is displayed upon display device **100** at a location below electronic document **140**. Note that audio gauge **242** may be overlaid on electronic document **140**. Reference markers **232** and **234** graphically connect audio gauge **242** with electronic document **140**. Reference markers **232** and **234** extend from time-dependent locations on audio gauge **242** to user-specified locations within electronic document **140**. In one embodiment, reference markers **232** and **234** are rendered semi-transparently to allow the contents of electronic document **140** to be visible through reference markers **232** and **234**.

In an exemplary embodiment, reference markers **232** and **234** are generated on display device **100** while audio is being

recorded by control unit **150**. Recall that according to one embodiment, audio is recorded and an audio gauge **242** generated in response to the system (either control unit **150** or display device **100**) detecting a positional stimulus. As audio continues to be recorded, the size of the corresponding audio gauge **242** is proportionally adjusted so as to reflect the amount of audio recorded. In one embodiment, if the system detects an additional positional stimulus indicating a location on or substantially close to an electronic document while audio gauge **242** is being adjusted (e.g., audio is being recorded), the system generates a reference marker connecting the end-point of audio gauge **242** to that location indicated on the electronic document. In the case of audio gauge **242**, reference marker **232** is initiated by a positional stimulus detected at time **T1**, whereas reference marker **234** is initiated by a positional stimulus detected at a later time **T2**. In one embodiment, during replay of the recorded audio, reference marker **232** is displayed upon display device **100** when the recorded audio reaches time **T1** and reference marker **234** is displayed upon display device **100** when the recorded audio reaches time **T2**.

The location on an electronic document to which a reference marker is graphically connected may be represented by (x,y) coordinates in the case where an electronic document represents an image, or the location may be represented by a single coordinate in the case where an electronic document represents a linear document. Examples of linear documents may include a plain text document, a hypertext markup language (HTML) document, or some other markup language-based document including extensible markup language (XML) documents.

In one embodiment, if during audio recording the system detects an additional positional stimulus that is not located on or substantially close to an electronic document, control unit **150** generates an additional audio gauge rather than a reference marker. The additional audio gauge may be generated in a manner similar to the first audio gauge described above. In one embodiment, control unit **150** graphically connects multiple audio gauges in the order in which they were generated. Upon audio replay, control unit **150** may sequentially replay the recorded audio in the chronological order that the audio was recorded. In one embodiment, one or more progress indicators may be utilized to display the amount of audio played with respect to each audio gauge. In another embodiment, a single progress indicator that sequentially travels from one audio gauge to another corresponding to the order of audio replay may be used.

In one embodiment, objects such as audio gauges, reference markers, electronic document thumbnails and icons may be repositioned individually or as a group, anywhere on display device **100** using conventional “drag” operations.

In another embodiment, neither the audio gauges nor the reference markers are displayed as recording occurs. However, a datafile is created that includes locations of the referenced documents and timestamps for when the references occurred. Details on such a data file are described in more detail below.

In one embodiment, the user speaking is recorded along with their “deictic” gestures (e.g., references to objects). In one embodiment, an interface includes a number of objects are displayed on the screen. In such a case, recording begins either when the user presses a “record” button or when the system detects the start of speech through its microphone. Whenever a user touches an object’s graphical representation on a touchscreen, a time-stamped event is recorded. Recording ends either when the user presses a “stop” button

or when the system detects end of speech. When playing back this message, the system plays the audio, and at the appropriate times displays the referred-to objects.

In one embodiment, the system allows the user to record an audio narrative and make references to digital photographs uploaded from a camera simply by touching them on a touchscreen. The resulting presentation is stored using the multimedia description languages SMIL and RealPix, allowing for playback using the widely distributed RealPlayer. A simple extension allows the user to refer to points or regions within objects by monitoring the locations “touched” more precisely. On playback, such gestures can become highlighting strokes overlaid on images or documents.

### Multimedia Chronicles

A multimedia chronicle is a particular type of audio narrative that includes a singular narration thread and one or more references to various types of electronic documents. Multiple sub-chronicles, each containing a singular narration thread, may be combined to form a larger multimedia chronicle. Within a multimedia chronicle it is possible for one or more persons to describe various types of electronic documents including, for example, but not limited to, a Web page with hyperlinks, a slide show containing audio narration, a text document containing text annotations, a scanned document image, a word processor document a presentation, etc. The references may refer to the contents of the entire electronic document or to a specific area within the electronic document. A linear ordering of sub-chronicles may also be specified allowing them to be played back in a default order.

FIG. **3A** illustrates an exemplary multimedia chronicle. Referring to FIG. **3A**, multimedia chronicle **300** includes first sub-chronicle **320** and second sub-chronicle **340**. First sub-chronicle **320** comprises narration thread **321**, and second sub-chronicle **340** comprises narration thread **342**. In one embodiment, a narration thread is a stream of recorded audio that follows a given theme or discussion topic. In FIG. **3A**, narration thread **321** is segmented into an ordered list of three separate audio clips, and narration thread **342** of sub-chronicle **340** comprises only single audio clip **344**.

Each narration thread may contain one or more references to various electronic documents. For example, narration thread **321** contains one reference to each of electronic documents **324**, **328** and **332**, for a total of three references. Narration thread **342**, however, contains only a single reference to single electronic document **346**. Each audio clip within a narration thread may contain any number of references to any number of electronic documents, or no references at all. For example, audio clip **322** contains a single reference to electronic document **324**, audio clip **326** contains one reference to electronic document **328** and one reference to electronic document **332**, and audio clip **330** does not contain any references.

Each reference may either indicate an entire electronic document, as shown by reference point **323**, or optionally indicate a specific area within an electronic document, as shown by reference points **327**. The coordinates representing such reference points may have different interpretations depending upon the type of electronic document they are referencing. For example, if the electronic document is an image, coordinates of the reference point may be absolute pixel coordinates. If the document is a web page, however, coordinates of the reference point may be a character position within an HTML file. In the case of a document stored as a series of page images, for instance, a scanned document,



the reference point may be a page number plus (x,y) coordinates. Alternatively, if a document is represented by a layout language, such as Postscript or PDF (Portable Document Format), the coordinate can be a character position within the file. Then, upon rendering (during playback), this can be translated to a position on the screen.

The multimedia chronicle described above with respect to FIG. 3A may be represented by one or more markup languages including XML and HTML. FIG. 3B illustrates one embodiment of an XML representation for the multimedia chronicle shown in FIG. 3A.

#### Multimedia Messaging

Electronic mail (email) software usually provides an option by which an original email message may be included in a reply. Typically an email reply can be interspersed among the lines of the original message, or it can be appended or prepended to the original message as a single block. Multimedia chronicles may similarly be transferred over a network using a variety of readily available email applications known in the art.

FIG. 4A illustrates one embodiment of a multimedia chronicle. Referring to FIG. 4A, electronic document 412 and icon 426 are shown along with two audio gauges 410 and 420 and various reference markers. Electronic document 412 represents a word processing document shown in a reduced "thumbnail" size, whereas icon 426 represents an iconized format of a similar word processing document in which the text of the document is not displayed. In one embodiment, the full text of the electronic document, represented by icon 426, may be viewed by "clicking" or selecting icon 426 with a cursor control input device such as a mouse. Audio gauge 410 is shown graphically connected to electronic document 412 by reference markers 414, whereas audio gauge 420 is shown graphically connected to icon 426 by reference marker 424.

Additionally, audio gauges 410 and 420 are shown connected together by connector 415 which indicates that the two audio clips represented by audio gauges 410 and 420 are chronologically adjacent (420 was recorded subsequent to 410). The connection may only indicate chronological ordering. However, a user can place gauges anywhere on the display. In one embodiment, audio clips recorded by the same user are considered to be related. In one embodiment the face image of the user who recorded the audio is displayed beside the corresponding audio gauge(s). In FIG. 4A, face image 402 represents user "A" who recorded the audio corresponding to audio gauges 410 and 420. In one embodiment, face images may be captured during recording by a video camera connected to the system, whereas in another embodiment, face images may be accessed from a database.

Once the multimedia chronicle illustrated by FIG. 4A is created, user "A" may send the multimedia chronicle to another user via electronic mail. In one embodiment, in order to send the multimedia chronicle to another user, an XML representation of the multimedia chronicle (such as that shown in FIG. 3B) is created. The XML representation references the various electronic documents and audio clips by way of URL addresses that point to their stored location (s). In one embodiment, the contents of a multimedia chronicle may be transferred to and stored on a designated web server, whereas in another embodiment, the contents may be stored locally on the user's personal computer. In an intranet environment, for example, contents of a multimedia chronicle may reside upon a user's personal computer and

yet be accessed by others through a web interface. Once an XML representation of the multimedia chronicle is created, a unique URL pointing to the XML representation is subsequently emailed to another user, say user "B".

Upon receipt of the email containing the XML URL, user "B" may have several viewing options. In one embodiment, upon accessing the URL containing the XML representation, the XML representation is parsed to create and play the message if user "B" has an appropriate application to view the XML representation. In another embodiment, where user "B" does not have an appropriate application to view the XML representation, the message may alternatively be displayed as a standard HTML-based web page. That is, the XML representation containing individual URLs pointing to one or more electronic documents and audio clips is displayed as a list of individual hyperlinks rather than a chronicle. In yet another embodiment, the message may be translated into a synchronized multimedia integration language (SMIL) formatted file as specified by the World-Wide Web (WWW) consortium. Using a "viewer" such as Real-Player G2 from Real Networks, Inc., user "B" may view the SMIL message as a slideshow in which the audio clips and corresponding electronic documents and references are simultaneously presented in an order, such as the order in which they were recorded.

Access to the received multimedia chronicle message may optionally be limited by access control functions. In one embodiment, a user may only retrieve the message if he or she is the sender or named recipient. In another embodiment, users may be required to authenticate themselves with, for example, a user name and/or password prior to accessing the message.

Once user "B" receives the message, user "B" may reply by adding additional electronic documents and audio clips (represented by audio gauges). FIG. 4B illustrates one embodiment of a reply to an electronic mail message containing the multimedia chronicle shown in FIG. 4A. In addition to the items shown in FIG. 4A, FIG. 4B additionally includes a third audio gauge 430 containing reference markers 434 and 436. Audio gauge 430 represents an audio clip that was added by user "B" to the original message shown in FIG. 4A. In one embodiment audio gauge 430, created by user "B", is displayed in a different color than audio gauges 410 and 420, created by user "A". Reference marker 436 graphically connects audio gauge 430 with newly added electronic document 438, whereas reference marker 434 graphically connects audio gauge 430 with previously displayed icon 426. User "B" can position gauge anywhere on screen, but lines shown connecting elements on the display indicate chronological ordering.

Once user "B" enters a response to the message or multimedia chronicle received from user "A", user "B" may send the reply back to user "A" or to some other user or group of users. Assuming the reply is sent back to user "A", in one embodiment, user "A" first hears the additions made to user "A's" message by user "B". That is, upon receipt, user "A" hears the recorded audio represented by audio gauge 430.

In one embodiment, a multimedia chronicle message may be displayed with separate user's additions or replies being selectively viewable. FIG. 4C illustrates one embodiment of a multimedia chronicle messaging interface that allows segments of the multimedia chronicle to be selectively viewed. Referring to FIG. 4C, messaging interface 465 is displayed upon display device 100. Messaging interface 470 includes audio gauges 440, 442, 450, and 452, faces 402,

and tabs **460–465**. Audio gauges **440** and **442** represent audio previously recorded by end user “A” (face **402**), and audio gauges **450** and **452** represent audio currently being composed by end user “A”. In one embodiment, each of tabs **460–465** is individually selectable and each may represent one segment of an ongoing conversation between user “A” and another user, such as user “B”. For example, when selected, tab **461** displays an original message from user “A” to user “B”. Tab **462** on the other hand displays user “B’s” reply to user “A’s” original message when selected. Likewise, when selected, tab **463** displays user “A’s” reply (shown by bounding box **445**) to user “B’s” reply. In one embodiment, any number of past messages or replies may be selectively viewed while a new message or reply is being composed. For example, user “A’s” reply (associated with tab **463** and shown by bounding box **445**) is concurrently displayed with a message that user “A” is in the process of composing (associated with tab **465** and shown by bounding box **455**). Once user “A” completes the message currently being composed, user “A” electronically mails the message in the manner described above. Tabs **460–465** may be labeled with the time of creation of the corresponding messages, as well as the names of the originators of the messages.

#### Three-Dimensional Walkthroughs

A method and apparatus for recording and playback of multidimensional walkthrough narratives is disclosed. A three dimensional modeling language is used to automatically create a three-dimensional environment using pre-existing electronic documents. Thus, the objects are 3D objects. In one embodiment, they are shown on a 2D display such as display device **100**. In another embodiment, a 3D display (e.g., head-mounted glasses) can be used.

A first user, or author, may navigate throughout the three-dimensional environment while simultaneously recording the path taken and any accompanying audio input. In one of two playback modes, a second user can be shown a “walkthrough” of the three-dimensional scene corresponding to the path taken by the author. In the other playback mode, a second user is free to navigate the three-dimensional world while the author’s path is displayed.

#### Generation

FIG. **5** illustrates one embodiment of a three-dimensional environment. Referring to FIG. **5**, display device **100** is shown displaying a three-dimensional environment or world containing cubes **510**, **515** and **520**. In one embodiment, the three-dimensional environment is empty except for cubes **510**, **515** and **520**. In another embodiment, the three-dimensional environment may contain additional aesthetic or substantive features as may be desired.

Cubes **510**, **515** and **520** are depicted in FIG. **5** as being three-dimensional and set within the three-dimensional world. In other embodiments, cubes **510**, **515** and **520** may be replaced by other figures of varying shape. In one embodiment, for example, the cubes may be replaced by three-dimensional spheres, whereas in another embodiment, the cubes may be replaced by three-dimensional cylinders or rectangular prisms. Figures of varying size and shape may be used without departing from the spirit and scope of the invention.

FIG. **5** additionally shows electronic documents **512**, **516** and **522** displayed upon cubes **510**, **515** and **520** respectively. In a three-dimensional environment, electronic documents **512**, **516** and **522** appear as being superimposed upon

cubes **510**, **515** and **520**. In one embodiment, electronic documents **512** and **522** represent digital photographs, whereas electronic document **516** represents a word processing document. Additional forms of electronic documents may include without limitation, digitized audio and video, electronic spreadsheets, electronic databases, hypertext markup language and web documents, and electronic mail. Electronic documents **512**, **516** and **522** may represent similar types of content and media not described herein.

In one embodiment, a two-dimensional reduced-size “thumbnail” image is created and superimposed upon a three-dimensionally rendered figure such as cubes **510**, **515** and **520**. In such a manner, a two-dimensional image can be converted into a three-dimensional representation of that image. In one embodiment, cubes **510**, **515** and **520** are defined through extended markup language (XML). In another embodiment a three-dimensional modeling language such as VRML, 3DML, and X3D may be used.

As each three-dimensional figure is generated, it is displayed within the three-dimensional environment. In one embodiment, each three-dimensional figure is randomly placed or displayed within the three-dimensional environment as it is generated. In another embodiment, each three-dimensional figure is displayed with respect to other pre-existing three-dimensional figures according to a placement scheme. In one embodiment, placement schemes are based upon characteristics of the electronic documents contained within the three-dimensional figures. Examples of placement schemes include, without limitation, time of creation, content, and media type. In yet another embodiment, the three-dimensional figures are displayed at a pre-determined fixed distance from one another. By displaying the three-dimensional figures according to various placement schemes, it is possible for an author to group or cluster certain types of information together to help guide user understanding. In one embodiment, the user, or one who navigates the three-dimensional environment after creation, is able to rearrange the three-dimensional figures according to their own organizational preference.

#### Recording

Once the three-dimensional environment is created, it may be navigated by a user. In one embodiment, navigation is possible through the use of a readily available “player” application including a virtual reality modeling language (VRML) viewer such as Cosmo Player available from Silicon Graphics, Inc., of Mountain View, Calif., or a three dimensional modeling language (3DML) viewer such as Flatland Rover available from Flatland Online Inc., of San Francisco, Calif. In one embodiment, a special class of user, called an author, is able to navigate through the three-dimensional environment while the author’s virtual movements are recorded. The term “recording” as used herein is meant to describe the process of retaining navigational and audio input as generated by a user with respect to the three-dimensional environment.

In an exemplary embodiment, an author navigates through a three-dimensional environment while a processing device, such as processor **102**, causes the author’s movements to be recorded. Any audio narrated by the author while navigating is also recorded, thus creating a walkthrough. In one embodiment, as the audio is recorded, it is segmented so as to divide the audio into multiple audio clips of varying duration according to a segmenting scheme. The audio may be recorded as described above. Thus, in one embodiment, a 2D multimedia chronicle is created and

viewed as a 3D walkthrough, and vice-versa. Similarly, in another embodiment, video content may be recorded and segmented in lieu of audio. As the author navigates toward a three-dimensional figure, the electronic document superimposed upon the figure appears larger to the author. By approaching the figure, the author may take a closer look at the figure or electronic document contained thereon. If so equipped, the player application may also provide the author the opportunity to view the electronic document in a separate, full-screen display, in another part of the display, or in a dedicated portion of the display overlaying the walk-through.

FIG. 6 illustrates a three-dimensional environment showing a recorded path according to one embodiment of the present invention. Referring to FIG. 6, display device 100 is shown displaying a three-dimensional environment containing three-dimensional cubes 510, 515 and 520, and path 610. Path 610 represents a path through which an author has navigated. Path 610 is shown as a line, but in other embodiments may take the form of various other shapes. In one embodiment, path 610 is displayed in a single color, while in other embodiments, path 610 may be displayed in multiple colors, or may appear semi-transparent.

FIG. 7 illustrates one embodiment of a two-dimensional top view of the three-dimensional environment shown in FIG. 6. Referring to FIG. 7, three-dimensional cubes 510, 515 and 520 are shown within proximity indicators 710, 715 and 720 respectively. In one embodiment, each of proximity indicators 710, 715 and 720 represent a bounded area that is associated with a particular media clip or segment. In one embodiment, the media clip contains audio content, whereas in another embodiment, the media clip contains video content.

In one embodiment, each proximity indicator is associated with an audio or a video segment that presumably relates to the three-dimensional figure bounded by the proximity indicator. In one embodiment, multiple three-dimensional figures may exist within a single proximity indicator, and in another embodiment, multiple proximity indicators may bound a single three-dimensional figure.

#### Playback

A user of the three-dimensional multimedia narrative described herein can choose whether to pursue playback of the recorded three-dimensional walkthrough in passive or active modes.

According to one embodiment, in a passive mode, the playback is movie-like in that the user is shown a three-dimensional walkthrough corresponding to the path taken by the author when the walkthrough was recorded. In one embodiment, audio narration that was recorded by the author is also played while in a passive mode. As documents are passed in a passive mode, the viewing user can also view the source of the documents in a separate window or viewing application.

In an active playback mode, the user is free to navigate the three-dimensional environment without being limited by the author's previously taken path. According to one embodiment of the present invention, while in active mode, the author's path remains visible as the user navigates through the three-dimensional environment. In yet another embodiment, segmented audio recorded by the author is played as the user approaches a related three-dimensional figure. Referring once again to FIGS. 6 and 7, as a user navigates along the author's path 610 and approaches cube 510, the user hears an audio segment recorded by the author

while the author was within proximity indicator 710. In one embodiment, the audio would not be played until the user navigated to within the area bounded by proximity indicator 710. In another embodiment, the loudness of the audio may increase as the user approaches cube 510. Additionally, stereo effects may be used to locate audio within three-dimensional space corresponding to the position of the cube in the virtual three-dimensional environment.

In the foregoing specification, the invention has been described with reference to specific embodiments thereof. It will, however, be evident that various modifications and changes can be made thereto without departing from the broader spirit and scope of the invention. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

I claim:

1. A method comprising:

generating a multidimensional representation of a plurality of electronic documents within a three-dimensional environment;

recording a narrative of the multidimensional representation; and

storing the multidimensional representation and the narrative to allow playback in at least one of a plurality of modes.

2. The method of claim 1, wherein generating a multidimensional representation of a plurality of electronic documents comprises:

generating a first three-dimensional figure upon which a first of the plurality of electronic documents is superimposed; and

displaying the three-dimensional figure within the three-dimensional environment.

3. The method of claim 2, further comprising:

generating a second three-dimensional figure upon which a second of the plurality of electronic documents is superimposed; and

displaying the second three-dimensional figure within the three-dimensional environment.

4. The method of claim 3, wherein the first and second three-dimensional figures are displayed within the three-dimensional environment in an order representing their respective times of creation.

5. The method of claim 3, wherein the first and second three-dimensional figures are displayed within the three-dimensional environment at a fixed distance from each other.

6. The method of claim 3, further comprising:

generating a third three-dimensional figure upon which a third of the plurality of electronic documents is superimposed; and

displaying the third three-dimensional figure within the three-dimensional environment.

7. The method of claim 6, wherein the third three-dimensional figure is displayed proximately to the first three-dimensional figure if the first three-dimensional figure and the third three-dimensional figure have electronic documents containing similar content displayed thereon, and

the third three-dimensional figure is displayed proximately to the second three-dimensional figure if the second and third three-dimensional figures have electronic documents containing similar content displayed thereon.

8. The method of claim 6, wherein the third three-dimensional figure is displayed proximate the first three-

## 15

dimensional figure if the first and third three-dimensional figures have electronic documents of a similar media type displayed thereon, and

the third three-dimensional figure is displayed proximate the second three-dimensional figure if the second and third three-dimensional figures have electronic documents of a similar media type displayed thereon.

9. The method of claim 2, wherein generating a three-dimensional figure includes:

representing the first of a plurality of electronic documents as a two-dimensional thumbnail image, and utilizing a modeling language to convert the two-dimensional thumbnail image into the three-dimensional figure.

10. The method of claim 9, wherein the modeling language utilized is at least one of VRML and 3DML and X3d.

11. The method of claim 2, wherein the first three-dimensional figure is a cube having six sides.

12. The method of claim 1, wherein recording a narrative of the multidimensional representation further comprises:

recording movements and audio of an author as the author navigates through the three-dimensional environment.

13. The method of claim 12, wherein the recorded movements of the author are displayed in the three-dimensional environment so as to visually indicate a path taken by the author.

14. The method of claim 13, wherein the plurality of playback modes includes:

a passive mode, wherein navigation by a user through the three-dimensional environment is restricted to the path taken by the author; and

an active mode, wherein the user is able to freely navigate through the three-dimensional environment.

15. The method of claim 12, wherein the recorded audio of the author is segmented into a plurality of audio segments and each of the plurality of audio segments is correlated to one of the plurality of electronic documents that is nearest the location of the author at a moment in time when the audio was recorded.

16. A method of representing a multidimensional electronic document comprising:

generating a plurality of three-dimensional figures; superimposing upon the three-dimensional figures a plurality of electronic documents;

generating a three-dimensional environment within which the plurality of three-dimensional figures are to be displayed;

displaying within the three-dimensional environment, the plurality of three-dimensional figures according to a placement scheme; and

playing a previously recorded narrative of the three-dimensional figures, wherein playback can occur in at least one or a plurality of modes.

17. The method of claim 16, wherein the first three-dimensional figure approximates the shape of at least one of a cube, a sphere, a cylinder, and a rectangular prism.

18. The method of claim 16, wherein a placement scheme orders a first three-dimensional figure and corresponding electronic document and a second three-dimensional figure and corresponding electronic document according to content.

19. The method of claim 16, wherein a placement scheme orders a first three-dimensional figure and corresponding electronic document and a second three-dimensional figure and corresponding electronic document according to media type.

## 16

20. The method of claim 16, wherein a placement scheme orders a first three-dimensional figure and corresponding electronic document and a second three-dimensional figure and corresponding electronic document according to time of creation.

21. The method of claim 16, wherein a placement scheme places a first three-dimensional figure at a predetermined distance from a second three-dimensional figure.

22. The method of claim 16, wherein the three-dimensional environment is generated using a modeling language including at least one of VRML and 3DML and X3D.

23. An article of manufacture comprising a computer-readable medium having machine readable instructions stored thereon, wherein when the instructions are executed by a processor, the instructions cause the processor to:

generate a multidimensional representation of a plurality of electronic documents within a three-dimensional environment;

record a narrative of the multidimensional representation; and

store the multidimensional representation and the narrative to allow a playback of a previously recorded narrative of the multidimensional representation, wherein the playback can occur in at least one of a plurality of modes.

24. The article of claim 23 wherein the instructions that cause the processor to generate the multidimensional representation of the plurality of electronic documents comprises instructions that, when executed by the processor, cause the processor to:

generate a first three-dimensional figure upon which a first of the plurality of electronic documents is superimposed; and

display the three-dimensional figure within the three-dimensional environment.

25. The article of claim 24 further comprising instructions that, when executed by the processor, cause the processor to: generate a second three-dimensional figure upon which a second of the plurality of electronic documents is superimposed; and

display the second three-dimensional figure within the three-dimensional environment.

26. The article of claim 25 wherein the first and second three-dimensional figures are displayed within the three-dimensional environment in an order representing their respective times of creation.

27. The article of claim 25 wherein the first and second three-dimensional figures are displayed within the three-dimensional environment at a fixed distance from each other.

28. The article of claim 25 further comprising instructions that, when executed by the processor, cause the processor to: generate a third three-dimensional figure upon which a third of the plurality of electronic documents is superimposed; and

display the third three-dimensional figure within the three-dimensional environment.

29. The article of claim 28 wherein the third three-dimensional figure is displayed proximately to the first three-dimensional figure if the first three-dimensional figure and the third three-dimensional figure have electronic documents containing similar content displayed thereon, and the third three-dimensional figure is displayed proximately to the second three-dimensional figure if the second and third three-dimensional figures have electronic documents containing similar content displayed thereon.

**30.** The article of claim **28** wherein the third three-dimensional figure is displayed proximately to the first three-dimensional figure if the first three-dimensional figure and the third three-dimensional figure have electronic documents of similar media type displayed thereon, and the third

**31.** The article of claim **24** wherein the instructions that cause the processor to generate the three-dimensional figure comprises instructions that, when executed by the processor, cause the processor to:

represent the first plurality of electronic documents as a two-dimensional thumbnail image; and

utilize a modeling language to convert the two-dimensional thumbnail image in the three-dimensional figure.

**32.** The article of claim **31** wherein the modeling language utilized comprises at least one of VRML and 3DML and X3d.

**33.** The article of claim **24** wherein the first three-dimensional figure is a cube having six sides.

**34.** The article of claim **23** wherein the previously recorded narrative of the multidimensional representation comprises recorded movements and audio of an author as the author navigates through the three-dimensional environment.

**35.** The article of claim **34** wherein the recorded movements of the author are displayed in the three-dimensional environment so as to visually indicate a path taken by the author.

**36.** The article of claim **35** wherein the plurality of playback modes includes:

a passive mode, wherein navigation by a user through a three-dimensional environment is restricted to the path taken by the author; and

an active mode, wherein the use is able to freely navigate through the three-dimensional environment.

**37.** The article of claim **34** wherein the recorded audio of the author is segmented into a plurality of audio segments and each of the plurality of audio segments is correlated to one of the plurality of electronic documents that is nearest

the location of the author at the moment in time when the audio was recorded.

**38.** An article of manufacture comprising a computer-readable medium having machine readable instructions stored thereon, wherein when the instructions are executed by a processor, the instructions cause the processor to:

generate a plurality of three-dimensional figures;

superimpose upon the three-dimensional figures a plurality of electronic documents;

generate a three-dimensional environment within which the plurality of three-dimensional figures are to be displayed;

display within the three-dimensional environment, the plurality of three-dimensional figures according to a placement scheme; and

play a previously recorded narrative of the three-dimensional figures, wherein playback can occur in at least one or a plurality of modes.

**39.** The article of claim **38** wherein the first three-dimensional figure approximates the shape of at least one of a cube, a sphere, a cylinder, and a rectangular prism.

**40.** The article of claim **38** wherein a placement scheme orders a first three-dimensional figure and corresponding electronic document and a second three-dimensional figure and corresponding electronic document according to content.

**41.** The article of claim **38** wherein a placement scheme orders a first three-dimensional figure and corresponding electronic document and a second three-dimensional figure and corresponding electronic document according to media type.

**42.** The article of claim **38** wherein a placement scheme orders a first three-dimensional figure and corresponding electronic document and a second three-dimensional figure and corresponding electronic document according to time of creation.

**43.** The article of claim **38** wherein a placement scheme places a first three-dimensional figure at a predetermined distance from a second three-dimensional figure.

**44.** The article of claim **38** wherein the three-dimensional environment is generated using a modeling language including at least one of VMRL and 3DML and X3d.

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